A perspective from space to help analyze…

THE OZONE LAYER

Chief Optical Design Engineer Dave Gutierrez examines the mock-up of the spherical polarizing prism used in the High Resolution Ozone Image. The prism generates the spectrum that helps identify changes in stratospheric ozone. The prism is technologically significant because it represents the ability to adapt an infrared spherical prism concept into an ultraviolet imaging instrument.

A potential link between space launches and ozone depletion has Air Force environmentalists and scientists looking for new ways to collect data on the subject. Thanks to a project collaboration between Los Angeles AFB's Space and Missile Systems Center and the Aerospace Corporation, these experts may soon have a high-tech tool: a sensor designed to "photograph" the ozone layer.

Above the stratosphere

The High Resolution Ozone Imager is a space-based sensor designed to study the Earth's ozone layer from above the stratosphere. This would allow scientist to analyze the layer's changes after rocket and missile launches, said John Edwards, Environmental Management Division chief, Space and Missile Systems Center, Los Angeles AFB, Calif. Aerospace Corporation researchers are testing a prototype, that became functional in December.

The corporation's engineers have developed a state-of-the-art spectrograph system, according to Dave Gutierrez, the project's chief optical design engineer.

"These [sensor] spectrographs use innovative prism technology to provide both the dispersing and imaging properties needed to make the measurement. They are also capable of measuring the polarization state of each wavelength, thus enhancing the data they provide," Gutierrez said. Spectrographs split light into its respective wavelengths, measuring their position and intensity.

If funded, the sensor would be mounted on a satellite in a polar orbit about 800 kilometers above the earth, according to Dr. Dave Gorney, principal director of Aerospace's Office of Research and Program Support. It would monitor the area of the atmosphere affected by the rocket launch exhaust, the launch corridor, to detect changes in the intensity of solar ultraviolet light reflected from the stratosphere.

Monitoring launches worldwide

"A space-based instrument such as [this] will be in the best position physically to observe the areas directly affected by a rocket launch," Edwards said. When in orbit, it would have the unique ability to provide three-dimensional images of ozone depletion in the launch corridor, and be able to monitor launches from any place on the planet.

The sensor would monitor the ozone-depleting effects of one-fourth to one-half of all launches taking place during its mission window – without cooperative launch scheduling. It would monitor not only ozone-depleting chemicals from solid-fueled rockets, but also from any launch vehicle using a propellant, launched from any country.

According to Edwards, this data would respond to international interest in ozone depletion and the Air Force's proactive strategy to reduce it use of ozone-depleting chemicals. However, he noted, launch vehicles are not perceived by some as large contributors to ozone depletion and are not listed as Class I ODCs in neither the Clean Air Act nor the Montreal Protocol, two efforts to reduce such compounds.

Still, an Aerospace Corporation study maintains that the Space and Missile Systems Center's space launch vehicles may annually deplete stratospheric ozone at a rate 10 times chlorofluorcarbons are eliminated, the impact of launch vehicles may receive more attention from the regulatory community, according to Edwards.

Regulatory compliance

"The regulatory requirement currently driving the sensor's development is the National Environmental Policy Act, which requires that an agency understand the impacts of its programs, report them to the public, and make decisions that will reduce those impacts," said Edwards. "Gathering as much data as we can on the subject can help drive efforts to develop alternative propellants that will not cause ozone depletion and allow us to meet these requirements." Additionally, scientists at Phillips Laboratory, Edwards AFB, Calif., are currently developing alternative "clean" propellants.

The sensor would provide the Air Force with a "stable, easy to use, compact, durable and inexpensive vehicle for measuring the effect of rocket exhaust on stratospheric ozone," Christensen said. He said the sensor can also provide high-resolution, three-dimensional imaging of any changes in the Antarctic ozone hole. It can also create detailed maps of the amount and distribution of smog in residential areas.

Transfer to industry

Some of the sensor's technology may also find its way into the commercial industrial sector where ultra-violet spectrometers and prisms are used, according to Christensen.

"The Air Force has an established technological need to better determine the effect of rocket launches on the environment, said Capt. Marvin Smith, pollution prevention program manager for Air Force Space Command headquarters. "As the operational users of space science and technology, we rely on SMC for technical solutions to problems facing our weapons system programs. Right now, a Space Command priority is to gather stratospheric ozone layer."

by Howard Antelis • Los Angeles AFB environmental public affairs